

© Copyright 2015 RBN Energy

## It Don't Come Easy: *Low Crude Prices, Producer Breakevens and Drilling Economics*



- The more than 50% fall in crude prices since June 2014 and 30% fall in natural gas since November 2014 have crushed producer internal rates of return (IRRs) for typical wells in U.S. shale plays.
- Analysis of IRRs and crude breakevens provides insight into what will happen to production as producers scramble to respond.
- Continued growth in shale production is related to IRR economics, but with several caveats that affect producers including high IRRs in drilling sweet spots, the impact of hedging, HBP, lower services costs and the number of hold over completions from last year.
- This report includes results from IRR and breakeven sensitivity analysis by basin and commodity using the RBN Production Economics model and input well data from a variety of sources.
- Coming up with input variables that represent wells in different plays is as much art as science. To fully understand the significance of the analysis, it is important that you know what you are looking at. We lay out our analysis for you so you can make your own judgments about our methodology and model input data.

In recent days the relentless fall in crude prices seems to have slowed, but a further decline is certainly possible, if not likely. As everyone who watches the oil market knows by now – the price crash has resulted from an oversupply of crude in world markets, partially due to relentless increases in production from U.S. shale plays which have pushed out almost 5 MMb/d of net crude oil and petroleum product imports over the past five years. At this point there appears to be little sign of enough short term demand increases to soak up excess barrels or cutbacks by major producers – including OPEC. Here is where we are today – in a market still searching for a bottom. The price of CME NYMEX crude futures for U.S. domestic benchmark West Texas Intermediate (WTI) is down 57% from its high of \$107/Bbl in June 2014 to \$45.59/Bbl – including a fall of 14% so far in 2015. The price of international benchmark crude Brent ICE futures has tumbled equally far and fast – down 58% since June 2014 and 15% so far in 2015 to \$48.79/Bbl on January 23, 2015. Brent premiums to WTI have averaged less than \$3/Bbl this year so far compared to an average of \$6.50/Bbl during 2014, removing some of the price advantage that domestic crudes have held over international competitors for much of the past four years. On its

own, this crude price carnage is enough to throw a curve ball at producer rates of return for U.S. shale oil plays. To cite just one example, RBN's analysis indicates that producer internal rates of return (IRR's – calculated as the discounted cash flow rate of return) for a typical oil well in the North Dakota Bakken shale play fell from 39% in the fall of 2014 with WTI priced at \$90/Bbl to just 1% in January 2015 with WTI at \$45/Bbl. This is the first time since the onset of the shale revolution in crude oil markets that prices, and thus rates of return have seen such declines. These markets are now in uncharted territory.

As if the oil market free fall were not enough, a mild start to the 2014-15 winter and continued high production of natural gas have combined to push prices for U.S. benchmark Henry Hub, Louisiana CME NYMEX natural gas futures below \$3/MMBtu for the first time since 2012. These low prices are crushing the returns that producers make from dry natural gas shale plays – reducing typical IRRs in the Louisiana Haynesville dry gas shale play from 5% at \$3.75/MMBtu gas to **-4%** at \$3.00/MMBtu. (Note that for emphasis we show negative returns in red.) And despite falling natural gas prices, the ratio between WTI crude and Henry Hub natural gas is languishing at 16X (meaning crude in \$/Bbl is 16 times the price of natural gas in \$/MMBtu). That compares with a high ratio of 54X in 2012 and an average of 27X between 2009 and June 2014. This narrowing in the ratio between crude and natural gas prices has a knock-on effect on shale producer returns from “wet gas” plays. Prices for NGL's (the “liquids” extracted from wet or rich gas at gas processing plants) are also at multi-year lows – squeezed down by tumbling crude prices. That means typical IRR's from drilling in wet gas plays no longer get an uplift from higher NGL prices. As an example, previously healthy IRR's of 25% for typical wells in the South Texas Eagle Ford play at \$90/Bbl crude and \$3.75/MMBtu natural gas have fallen to **-3%** in 2015 at \$45/Bbl crude and \$3/MMBtu gas.

A somewhat counterintuitive point in all of this is that the immediate, short-term impact on the production volumes of crude, natural gas and NGL's resulting from the price crash is likely to be minimal. Existing wells that are currently flowing will continue to produce – there is no value to shutting in output because of falling prices. Even at today's prices, the per-unit revenues of existing wells are significantly above operating costs. In fact, production is likely to increase in the near term for at least four reasons: (a) Producers are cutting back drilling, but the rigs that are left are focused on their highest yield “sweet spots”, the best, largest producing opportunities. The producer's goal is to maximize revenue, and that means maximize production volume. (b) In recent years a number of leases signed by producers have HBP (held by production) clauses, requiring drilling and production to hold leases that were acquired at significant costs. Some wells will be drilled and produced to hold these leases, regardless of short-term economics. (c) Some producers were wise enough to hedge their prices, and will continue to drill and produce against those higher priced forward sales, and (d) producer economics will be improved by lower drilling service costs, which are coming down fast in response to lower drilling activity.

However, there is no doubt that over time lower prices will result in producers cutting their budgets for drilling new wells. This is already happening in shale plays across the country as producers, small and large, review how much they will invest in new production during 2015 and beyond. The analysis in this report lies at the heart of those investment decisions – determining which plays offer the best rates of return in a lower price environment.

Independent producers do not typically have the same deep pockets or access to bank finance as major oil companies. Continued drilling programs require new financing that either has to be borrowed or generated as cash flow from existing wells. The oil price crash has basically halved the revenue from existing wells. We calculate that U.S. shale producers can expect to receive about \$66 billion less cash flow revenue from existing crude production with prices at year end 2014 levels (\$53/Bbl) than at \$100/Bbl. That revenue is not now available for new drilling budgets

or to pay off existing bank loans. As a result producers need to be far more selective about where and when to drill.

Those decisions – how much to drill – when to drill and where – will determine the impact on crude, natural gas and NGL production during 2015 and beyond. As the number of rigs deployed to drill new wells declines, so will the rate of increase in production. As existing well flows decline, overall production will eventually fall unless enough new wells are drilled to replace the resulting drop in output or new wells are proportionately more productive. Whether enough new wells are drilled to maintain an increase in overall crude production will depend on drilling economics and the related appetite for new investment by producers. The latest Energy Information Administration (EIA) forecast (January 2015) indicates that U.S. crude output will increase in 2015 by 600 Mb/d to 9.3MMb/d and by 200 Mb/d to 9.5MM b/d in 2016.

For the moment producers are reviewing drilling programs and making selective cutbacks. Detailed information provided on rig deployment in North Dakota by the State Industrial Commission indicates the drilling rig count in that State was down from 191 in October 2014 to 181 in December 2014 and 156 in mid-January 2015 – a reduction of 35 rigs or 18% since October. Weekly national drilling rig counts from Baker Hughes show the total rig count (for oil and gas directed rigs) falling by 15% since mid-November 2014 with oil directed rigs down 17% since then. While drilling rig counts are an obvious and important leading indicator of production it should be noted that dramatic increases in rig productivity (output per rig) have been achieved in the past four years. As a result new well production numbers are frequently higher than existing wells – slowing the production decline even as the rig count falls and as we have said – allowing for overall continued increases in production. In most cases we expect producers looking at drilling program budgets today to concentrate their investment in the “sweet spots” of existing plays – where production and IRRs will be optimal. In such a lower price environment there are few budget dollars available for experimental drilling at the fringes of established plays to discover new opportunities. As stated above, expect instead to see reduced drilling, concentrated in sweet spots.

The primary purpose of this RBN Drill Down report is to provide an explanation and summary of analysis produced using RBN Energy's Production Economics Model to indicate what we believe are typical IRRs in different crude oil and natural gas price scenarios for major shale plays across the U.S. The analysis segments wells as to whether they produce predominately oil, dry natural gas or wet natural gas (containing NGLs) but incorporates the production of all three hydrocarbons in basins where most wells are “triple plays”. We also provide data for sweet spots in oil plays – to demonstrate that new drilling will continue in some locations with high IRRs even if prices continue to fall. In addition to IRR's we provide an analysis of breakeven prices for crude oil plays – calculated as the price that results in a zero % IRR in a given natural gas price scenario.

We also provide a thorough description of the assumptions behind our analysis using the RBN Production Economics model. We introduced the model in the fall of 2013 as part of our blog series [“The Truth is Out There - Unconventional Production Economics”](#). That first iteration looked solely at one commodity – natural gas. Last year (2014) we expanded the model to cover all three “drill-bit hydrocarbons” – crude oil, natural gas and NGLs. We used the expanded version as part of our Drill Down report on growing production in the Permian Basin last May (see [Stacked Deck](#)) and we provided a downloadable version of the spreadsheet model with that report. This time we provide summary analysis based on running multiple sets of data and scenarios through the model.

The report layout is as follows:

In Section 1 we provide background and detail on the price crash, crude-to-gas ratio and the impact on producer revenues.

In Section 2 we review the basics of shale drilling technology and productivity enhancements that continue to improve drilling efficiency.

In Section 3 we discuss the assumptions and input variables used in RBN's IRR and breakeven analysis using the Production Economics model.

In Section 4 we present the results of our IRR and breakeven analysis

The U.S. oil and gas industry has entered a new phase in 2015, characterized by revolutionary new technologies that reduce the per-unit cost of production, and now lower prices, that make those lower costs essential to viable production economics. The only way to grasp how this drama will play out over the next few years is to have a full appreciation of how those economics will impact the behavior of U.S. producers. The goal of this RBN Drill Down report is to shed light on some of the most important calculations that will impact that behavior.

***This RBN Energy Drill-Down Report is available for individual subscription at [rbnenergy.com](http://rbnenergy.com) as part of RBN's Backstage Pass premium content service.***

***For more information on group subscriptions, send an email to [info@rbnenergy.com](mailto:info@rbnenergy.com) or call 888-613-8874.***

**The Table of Contents for "It Don't Come Easy" is included on the following pages.**

## Table of Contents

<b>Introduction</b> .....	<b>- 1 -</b>
<b>Section 1 – Prices and Production</b> .....	<b>- 7 -</b>
1.1 Price Crash .....	- 7 -
1.2 Cash Flow Impact of the Price Crash.....	- 8 -
1.3 Production Impact .....	- 9 -
<b>Section 2 – Drilling Technology</b> .....	<b>- 11 -</b>
2.1 Background .....	- 11 -
2.2 Horizontal Drilling and Fracking 101 .....	- 12 -
2.3 Evolution of Fracking.....	- 14 -
2.4 Productivity Improvements .....	- 14 -
<b>Section 3 – Scenario Analysis Assumptions and Variables</b> .....	<b>- 15 -</b>
3.1 Drilling and Completion Costs .....	- 15 -
3.2 Operating Expenses.....	- 17 -
3.2.1 <i>Production Taxes</i> .....	- 17 -
3.2.2 <i>Royalty Rates</i> .....	- 17 -
3.3 Initial Production, Decline Rates and Estimated Ultimate Recovery .....	- 17 -
3.4 RBN Production Economics Model Analysis.....	- 19 -
3.4.1 <i>Decline Rates and Decline Curves</i> .....	- 19 -
3.4.2 <i>Estimated Ultimate Recovery</i> .....	- 19 -
3.4.3 <i>Cost Inputs</i> .....	- 19 -
3.4.4 <i>Production Inputs</i> .....	- 20 -
3.4.5 <i>Commodity Price Inputs</i> .....	- 20 -
3.4.6 <i>Model Outputs</i> .....	- 21 -
3.5 RBN IRR and Breakeven Analysis .....	- 22 -
3.5.1 <i>Coverage and Categorization</i> .....	- 22 -
3.5.2 <i>Premises</i> .....	- 23 -
<b>Section 4 – IRR and Breakeven Analysis Results</b> .....	<b>- 24 -</b>
4.1 Then and Now .....	- 24 -
4.2 Typical Oil Plays.....	- 26 -
4.3 Sweet Spots in Oil Plays .....	- 28 -
4.4 Breakeven Analysis of Crude Plays .....	- 29 -

---

4.5	Gas Liquids Plays – Alternative Crude Price Scenarios.....	- 30 -
4.6	Gas Liquids Plays – Gas Price Scenarios.....	- 32 -
4.6.1	<i>Crude and Liquids Sensitivity to Oil Prices.....</i>	- 32 -
4.6.2	<i>Dry Gas Plays – Gas Price Sensitivities.....</i>	- 33 -
4.6.3	<i>Gas and Liquids Sensitivity to Gas Prices.....</i>	- 33 -
<b>Conclusions</b>	.....	<b>- 34 -</b>